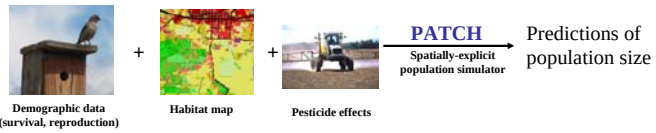
Using Population Models to Evaluate Risk in Populations of Birds

Author(s): Laura R. Nagy and Nathan Schumaker
Affiliation(s): USEPA, ORD, Western Ecology Division

The U.S. EPA has been challenged to develop risk assessment tools that predict with reasonable accuracy long-term effects of pesticides on songbird populations. Here, we parameterized the PATCH wildlife simulation model (a spatially-explicit, individual based life history simulator) with data from a 3-year study of the western bluebird (*Sialia mexicana*) to evaluate 1) the effects of a hypothetical pesticide alone and in combination with environmental variability, 2) the population-level differences between a widespread pesticide and a pesticide that is applied locally, and 3) the time until recovery when a pesticide is applied and then discontinued. Our modeling results elucidated multiple important points. First, our modeled population had a greater, and unpredictable response (e.g., extinction) when the pesticide was combined with high environmental variability. Second, changes in population size were highly dependent on the habitats associated with the pesticide application; therefore, generalizing across habitats will overestimate the impacts of the pesticide. Finally, even when pesticides were applied for a narrow time window (e.g. 10 yrs), populations required 10 to 30 years to recover to their original size, even when no new stressors occurred. We conclude that without addressing natural stressors, the geographic extent of the pesticide application, and the timeframe of the pesticide applications, models addressing population-level impacts of pesticide applications may over or under-estimate the impacts of pesticides on the wildlife populations of interest.

1) How do we estimate population risk?

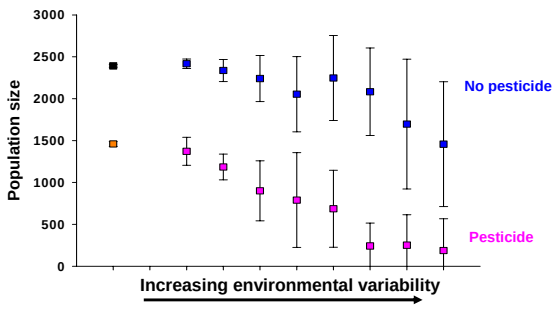
- Use computer models to simulate the effect of a pesticide on a population of interest (here, Western Bluebirds using a spatially-explicit, individual-based model)



2) Do pesticides have different effects in variable environments?

METHODS

- Exposed a population of western bluebirds to a hypothetical pesticide that decreases reproductive success by 20%
- Ran simulations with and without a pesticide in constant or variable environments



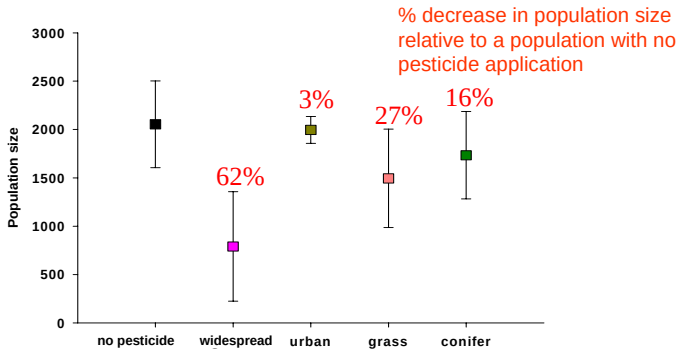
CONCLUSIONS

- The impact of the pesticide on the simulated population increased with environmental variability.

3) How does local or widespread application of the pesticide affect bird populations?

METHODS

- Based on hypothetical pesticide that reduced reproductive success (i.e., number of young produced per female) by 20%
- Pesticide applied either to all habitats in the landscape or strictly to a single habitat type



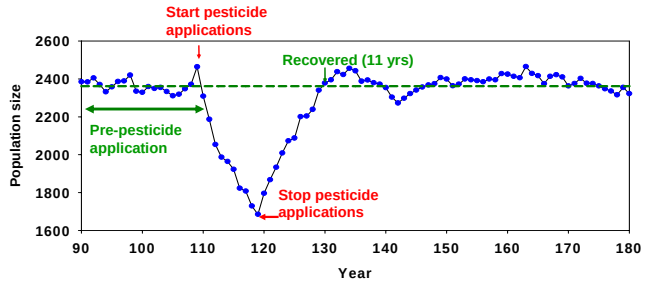
CONCLUSIONS

- Although most population-level risk assessments assume a widespread application of a pesticide, this practice overestimates the population-level effects of the pesticide

4) What is the recovery time of a bird population after a pesticide application?

METHODS

- Modeled reproduction and survival of a natural population
- Applied a pesticide for a period of 10 yrs
- Examined population recovery after the pesticide application



CONCLUSIONS

- Populations required 10+ years to recover to their original size after the pesticide use ended
- Future directions include examining the effects of pulsed pesticide applications